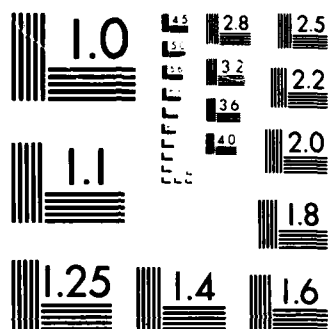


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AN EVALUATION OF THE C-F  
COST ALLOCATION ALGORITHMS  
IV: INSTALLATION SUPPORT

by

Patricia H. Weber  
Gregory J. Zunic

— STATISTICS —

— OPERATIONS RESEARCH —

— MATHEMATICS —

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*Applied Research in Statistics - Mathematics - Operations Research*

## AN EVALUATION OF THE C-E COST ALLOCATION ALGORITHMS IV: INSTALLATION SUPPORT

by

Patricia H. Weber  
Gregory J. Zunic

TECHNICAL REPORT NO. 118-5

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## EXECUTIVE SUMMARY

This report by Desmatics, Inc. is the fourth in a series of volumes which review procedures used by the Communications-Electronics (C-E) subsystem of VAMOSC to allocate operating and support costs to ground communications-electronics and meteorological equipment. It presents the results of an examination of the algorithms and data used by the C-E system to allocate Base Operating Support (BOS) costs, Real Property Maintenance (RPM) costs, and Communications costs. These costs comprise the broader category Installation Support. The unit TMS allocation factor algorithm is also evaluated in this report. This factor is used to allocate organizational level costs to end items in an organization's inventory, not only in the three algorithms in Installation Support, but in several others as well.

In Desmatics' opinion the unit TMS allocation factor is inappropriate for allocating all three subcategories of Installation Support costs in the C-E system. In addition, the formulation of this factor must be altered in order to prevent overstatement of the costs being allocated, if the factor is to be applied to other algorithms.

The FY82 method for processing BOS costs is a considerable improvement over the FY81 method. However, Desmatics recommends a number of refinements to the data selection and allocation which will further improve the quality of this reported cost.

Desmatics also recommends a number of changes to the C-E system processing of RPM costs. Desmatics proposes using an alternate data source (H069R), and also recommends an allocation based on personnel

strengths as being more relevant.

There are several mathematical problems with the Base Communications Factor, which is used by the C-E system to allocate Communications costs. Desmatics provides a revised algorithm, which overcomes this and other problems associated with the current Communications cost algorithm. This suggested algorithm also obviates the requirement for the collection of unit level communication data.

Several of the algorithms used in the C-E system are subject to large rounding errors. This results from the lack of sufficient precision in the allocation factors. Desmatics recommends that the factors involved be carried with additional decimal places in the files to minimize rounding errors when they are used in calculating allocated costs.

Desmatics also recommends that the C-E system report installation support strengths on the C-E O&S Cost Report. This would provide additional information for a user and would also place C-E in compliance with Cost Analysis Improvement Group (CAIG) guidelines in this area. Desmatics provides methodology to calculate these strengths and suggests a reporting format for them.

In summary, Desmatics makes a number of recommendations for changes in the C-E system processing of Installation Support costs. Desmatics also proposes new methods for allocating these costs. All of these changes should improve the C-E processing of these costs, increase the utility of the C-E O&S Cost Reports, and also provide closer compliance with the CAIG reporting guidelines.

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## I. INTRODUCTION

Desmatics, Inc., under Contract No. F33600-82-C-0466, is conducting an evaluation of the cost allocation algorithms employed in the Ground Communications-Electronics (C-E) subsystem (D160A) of VAMOSC, the Air Force Visibility and Management of Operating and Support Costs System. This report is the fourth in a set of volumes which discuss the scope and findings of the Desmatics evaluation efforts.

The purpose of this volume is to evaluate the allocation of the following subcategories of Installation Support costs to C-E end items at the Type Model Series (TMS) level: Base Operating Support (BOS), Real Property Maintenance (RPM), and Communications (COM). Prior to FY82 Medical (Health Care) costs were also included in the Installation Support cost category. These are now included with Indirect Personnel costs and will be discussed in a forthcoming volume dealing with this cost category.

This report consists primarily of a qualitative examination which evaluates the face validity of the C-E system logic. It evaluates the reasonableness of the procedures used for selecting, calculating, and allocating the above-mentioned costs to TMSs, assessing whether they may be expected to provide equitable results. Quantitative evaluations are included where appropriate.

Desmatics has made a number of specific recommendations which are enumerated in Section IX of this report. The corresponding responses and comments of the Office of VAMOSC accompany each recommendation.



The Statement of Work under which this Desmatics study was initiated calls for the evaluation of the C-E system algorithms as set forth in the draft of the C-E User's Manual dated 1 July 1981. The current edition of this manual, AFR 400-31, Volume III, dated 12 August 1982 [17], was used for the evaluations in this volume. The C-E system has evolved almost continually since its inception, reflecting improvements that were made in virtually every aspect of the system prior to and following the first production runs in September 1982. Desmatics recognizes that to restrict its evaluation to the July 1981 baseline would significantly limit the usefulness of its findings. Accordingly, Desmatics has kept pace with the evolution of the C-E system and has attempted to reflect the significant system changes, specifically in those instances where a given cost was computed by different algorithms in two (or more) years. As a result, the documentation of Desmatics' findings is more complex than might otherwise be the case. For clarification, relevant portions of the discussions are specifically identified to the fiscal years to which they apply.

Desmatics has endeavored to have this volume reflect the current status of the Installation Support cost allocation algorithms within the C-E system. The authors feel that this has been accomplished. However, the reader must realize that should future C-E system changes impact on the algorithms discussed, portions of this report may become outdated.

## II. BACKGROUND

Installation Support includes the following three subcategories of costs: Base Operating Support (BOS), Real Property Maintenance (RPM), and Communications (COM). Base Operating Support costs are the indirect costs associated with providing various services (e.g., administration, information, comptroller, etc.) to C-E unit mission personnel. Real Property Maintenance costs are the costs associated with the operation and maintenance of real property facilities used by C-E units. Communications costs are the costs of base level communications support for C-E missions and their personnel.

Base Operating Support costs and Communications costs are obtained from the Accounting and Budget Distribution System (ABDS), DSD H069R by OAC/OBAN (Operating Agency Code/Operating Budget Account Number). Real property maintenance costs are obtained from the Command Civil Engineering and Military Family Housing Cost System, DSD F006, at the geographical location (GELOC) level. The processes used in determining Installation Support costs for each TMS worldwide are described in the following source documents:

- (1) AFR 400-31, Vol. III, C-E User's Manual [17],
  - (2) C-E System Specification, D160A [5],
  - (3) Subsystem Specification of the Preprocessor (VAMOH) [7],
  - (4) Tri-Service VAMOSC Conference Handouts, 1984 [6],
- and (5) Relevant Data Automation Requirements.

Two types of C-E equipment ownership situations were discussed in Volume I of this series [19]. One involves organizations which are primarily C-E mission-oriented, the other involves organizations in which the C-E mission is incidental to the primary mission. These situations affect some of the allocation algorithms discussed in this volume. Desmatics termed these two kinds of organizations "C-E" and "non-C-E" respectively [19]; this terminology is also used in this volume.

Each cost category under Installation Support is discussed in a separate section. Each of these sections includes a description of the process used in determining the cost attributable to each TMS, an evaluation of the face validity of the process, and a review of the appropriateness of the input data sources. In addition, there is a separate section devoted to the Unit TMS Allocation Factor. This section includes a process description of the algorithm by which the factor is developed and an evaluation of the validity of the factor. Included as well is a discussion of the appropriateness of the factor for allocation of each subcategory of cost in the Installation Support cost category. An additional section summarizes the conclusions and recommendations made by Desmatics based on its study of the determination of C-E Installation Support costs. Replies from the Office of VAMOSC are also included.

### III. UNIT TMS ALLOCATION FACTOR

In the C-E system the Unit TMS Allocation Factor is used to allocate a number of organizational level operating and support costs to end items. It is used in all three algorithms discussed in this volume: Base Operating Support, Real Property Maintenance, and Communications.

#### A. PROCESS DESCRIPTION

The Unit TMS Allocation Factor is defined [17] as "... the proportional cost of a specific type and quantity of C-E end item in a C-E organization in relationship to the total cost and quantity of all C-E end items in a C-E organization." The factor for any given TMS<sub>i</sub> in any given C-E organization, defined by  $f_{TMS_i}$ , is given by:

$$f_{TMS_i} = \frac{Q_i \times P_i}{(Q_1 \times P_1 + \dots + Q_n \times P_n)}$$

where  $Q_i$  = the quantity of TMS<sub>i</sub> owned by the organization (from D039, Equipment Item Requirements System, Format 100 Records),

$P_i$  = the AF stock list price of TMS<sub>i</sub> (from D039 Format 50 records),

and  $n$  = number of different C-E end items in the organization's inventory.

For FY82 the variable P was replaced with A/C, which is defined as Acquisition Cost [5]. However, this represents a change in nomenclature only; both variables are defined as the unit prices reported on D039 Format 50 records.

## B. EVALUATION

This evaluation addresses those general aspects of the unit TMS allocation factor which affect all of the allocations for which it is used. The appropriateness of the factor for allocating Installation Support costs is also discussed. Its relevance for other cost categories in the C-E system is, or will be, addressed in the volumes in this series devoted to those categories.

### 1. The Unit TMS Allocation Factor - Data Inputs

The Assets by Organization File (formed from D039 Format 100 and Format 50 records) used by the C-E system only contains records for assets with C-E FSCs (Federal Stock Classes) [5]. Since this file is used to provide inventory data for computing the unit TMS allocation factors, these factors are only based on inventory items with C-E FSCs. Unless the denominators of the factors contain data for all assets of a given organization, costs which rightfully should be assessed against non-C-E items will be entirely allocated to C-E end items. This is particularly problematical in the case of "non-C-E" organizations. Here the C-E equipment may represent a relatively minor part of the

organization's total inventory, yet effectively be burdened with all the organizational level costs in the category being allocated.

Desmatics therefore recommends that all Format 100 records from the D039 system be used to compute denominators for the unit TMS allocation factors, and that the factor be redefined to reflect this.

The unit TMS allocation factors distribute costs based on the value of any given TMS at an organization relative to the value of all (C-E) assets at the organization. Ideally, the inventory values used should be the current value of these assets. However, in view of the difficulties associated with estimating actual current inventory values, it is Desmatics' opinion that the best alternative is to use current replacement costs to compute the factors.

As pointed out in Volume III of this series [18], unit prices in the D039 system generally represent the unit price at last procurement, automatically adjusted for inflation. Item managers can update these prices, but such changes remain in effect only for the current quarterly processing. It appears that the intent of the D039 system pricing policy is to represent the current replacement cost of assets. For the reasons outlined in Volume III [18], however, these D039 prices are not likely to be representative of actual replacement costs. Nevertheless, the D039 system is the only source of price information for the unit TMS allocation factors. As before, Desmatics can only suggest that the Office of VAMOSC continue to use these prices and encourage efforts to effect improvements to this system in the area of unit pricing.

## 2. Allocation of Installation Support Costs

Desmatics does not concur with using the unit TMS allocation factor to allocate any of the three subcategories of Installation Support (BOS, RPM and COM) costs to end items in the C-E system. All of these support services represent the consumption of resources more for the benefit of personnel rather than equipment per se. Both BOS and COM costs involve direct support of personnel. Although RPM resources are consumed directly on behalf of facilities, personnel are still the primary beneficiaries. Desmatics therefore recommends allocating all three subcategories of Installation Support using ratios based on personnel strengths rather than equipment values. Accordingly, Desmatics has developed revised algorithms for processing each of these costs, i.e., BOS, RPM, and COM. They are presented in Sections IV, V, and VI, respectively.

#### IV. BASE OPERATING SUPPORT

Base Operating Support (BOS) costs in the C-E system are the indirect costs resulting from providing various services to C-E unit mission personnel [17]. BOS costs, as defined by the C-E system, are reported in the Accounting and Budget Distribution System (ABDS), Data System Designator (DSD) H069R, under Program Element Code (PEC) xxx96 [13]. This PEC covers a diverse group of services. Included are such things as administration, comptroller activities, and recreation activities.

##### A. PROCESS DESCRIPTION

The following process description is from the C-E User's Manual [17], and applies to the FY81 algorithm for BOS costs. (The algorithm for FY82 is discussed later in this section). For a given C-E end item,  $TMS_i$ , at a given base, the allocated BOS costs,  $bos_i$ , are given by:

$$bos_i = C \times F_{BOS} \times f_{TMS_i}$$

where  $C$  = BOS costs (PEC xxx96) for a base, from H069R, via D160. (VAMOH), for the OAC/OBAN of the supporting organization (the organization which provides the BOS services),

$F_{BOS}$  = the BOS factor (discussed later in this section) which allocates a share of the host BOS costs to the C-E organization,

$f_{TMS_i}$  = the unit TMS allocation factor for that C-E organization and  $TMS_i$ .



The worldwide BOS costs for TMS<sub>i</sub> are then obtained by summing the allocated costs for TMS<sub>i</sub> over all organizations which own it.

The BOS factor, which allocates a share of the supporting organizations' BOS costs to tenant organizations, is defined as follows:

$$F_{BOS} = \frac{N_O}{N_B}$$

where  $N_O$  = number of C-E people in the organization which owns the TMS, from the MPC (Military Personnel Center) Extract File (via the VAMOH preprocessor system), selected by PAS (Personnel Accounting Symbol), FAC (Functional Account Code), and AFSC (Air Force Specialty Code) [5,17],

and  $N_B$  = the total number of people at the GELOC where the organization owning the TMS is located, from the MPC Consolidated Personnel File (via VAMOH).

The unit TMS allocation factor is discussed in Section III of this report.

As noted above the BOS costs for this algorithm are selected by the OAC/OBAN of the supporting organization. In the C-E system an OAC/OBAN table is used to match the supporting organizations, which provide the BOS services, with tenant organizations which own the equipment (by OAC/OBAN). Data for this table is obtained from the C-E Unit Level Reports (RCS: HAF-LEY(A) 8119) which are completed annually for the Office of VAMOSC by all C-E organizations.

For FY82 a new algorithm for processing BOS costs was developed by the Office of VAMOSC [5,6]. The BOS costs for a TMS at a given organization are computed as follows:

$$bos_i = \frac{C_w}{N_w} \times N_o \times f_{TMS_i}$$

where  $bos_i$  = BOS costs for  $TMS_i$  at a given C-E organization,

$C_w$  = total worldwide AF BOS costs from H069R, C-E ASO extract, PEC xxx96, for the following commands:  
LOG, CSV, SYS, SAC, TAC, MAC, ATC, AFE, PAF, AAC,  
and ELC,

and  $N_w$  = total number of Air Force personnel worldwide  
(military and civilian) from the MPC Consolidated  
Personnel File.

The other variables,  $N_o$  and  $f_{TMS_i}$ , are as previously defined. As before, the worldwide BOS costs for the TMS are found by summing all the allocated BOS costs for the TMS over all organizations which own the TMS.

## B. EVALUATION

In this section the BOS cost allocation algorithms for FY81 and FY82 are discussed. In addition, an alternate algorithm for C-E BOS costs, which is basically a refinement of the FY82 cost allocation algorithm, is presented.

Costs in H069R are reported by OAC/OBAN; those selected for BOS in FY81 were only for the supporting organizations in the C-E OAC/OBAN Table. Personnel in the MPC Extract Files are reported and selected by PAS and corresponding GELOC. Since the cost data and personnel data are not at equivalent levels of identification and the system processing did not provide for matching costs with appropriate pools of personnel, BOS costs were often misallocated at the organizational level.

The major problem with the FY81 algorithm, misallocation of BOS costs to the organizational level, is illustrated by the following example involving a group of C-E organizations located in Turkey. In the FY82 Unit Factor Table there are nineteen organizations (identified by PAS) located there which have the same reporting OAC/OBAN (49GJ) and the same supporting OAC/OBAN (8061). The supporting OAC/OBAN is located at Incirlik Air Base, GELOC LJYC, yet only one of these nineteen supported organizations is also at this GELOC. Eleven others in the group are the only organizations at their listed GELOCs. Their FY81 BOS factors (number of C-E people in the organization divided by the total number of people at the GELOC) were approximately one, thus virtually all of the PEC xxx96 costs at LJYC were allocated to each of these organizations. In cases where supported organizations share a GELOC with other organizations having different supporting OAC/OBANs the denominators of the BOS factors for those supported organizations would be overstated, and costs understated.

Another problem is that some PEC xxx96 costs are reported in H069R for tenant organizations under their reporting OAC/OBANs. The C-E system disregarded these costs in FY81; this also caused understatement of total BOS costs for those organizations.

By summing BOS costs and AF personnel to the worldwide level to develop a BOS cost per person, as was done for FY82, the mismatches between costs and personnel counts were largely avoided. Although the FY82 algorithm is a great improvement over the FY81 process, further refinements are required to ensure that only relevant costs and personnel counts are included. These are discussed in the following subsections.

# 1. Use of Supported Strengths Rather Than Total Strengths

The total number of AF personnel worldwide, denoted as  $N_w$  in the FY82 BOS algorithm, includes both supporting and supported personnel. This means, in effect, that the portion of the BOS services consumed by support personnel is not allocated to C-E end items. Since at least some of these personnel are providing services which would not be required in the absence of C-E missions, Desmatics contends that this portion of BOS costs should be charged against the TMSs. Thus, Desmatics recommends that these support personnel be identified and excluded from the counts for  $N_w$  in the current algorithm.

This involves the creation of a new variable  $N_S$ , which can be defined as the worldwide number of AF supported personnel for BOS costs in the C-E system. Those (support) personnel which should be subtracted from  $N_w$  are BOS personnel (PEC xxx96), RPM personnel (PEC xxx94), and medical personnel (FAC 5xxx). The equation is:

$$N_S = N_w - N_M - N_B - N_R$$

where  $N_S$  = number of supported personnel for BOS in the C-E system,

$N_w$  = number of Air Force personnel worldwide, MPC Consolidated Personnel File,

$N_M$  = number of Medical Personnel (FAC 5xxx), MPC Consolidated Personnel File,

$N_B$  = number of BOS personnel (PEC xxx96), MPC Consolidated Personnel File,

and  $N_R$  = number of RPM personnel (PEC xxx94), MPC Consolidated Personnel File.

Since the identifying criteria differ for medical personnel, it is possible to double-count some of these records. Desmatics therefore recommends the following procedure for counting support personnel strengths:

- 1) Count all records in the MPC file with PEC xxx96 and PEC xxx94 to determine the value of  $N_B$  and  $N_R$  respectively.
- 2) Count all records in the MPC file with FAC 5xxx, except for those with PEC xxx94 or xxx96, to get  $N_M$ .

## 2. Correspondence of Cost and Personnel Data

Costs in the H069R C-E ASO Extract come from eleven commands: MAC, SAC, TAC, ATC, AFE, PAF, AAC, LOG, SYS, CSV, and ELC. Total BOS costs are all costs reported under PEC xxx96 for these eleven commands. Total personnel counts from the MPC Consolidated Personnel File, however, are from all commands. An examination of personnel records from Andrews AFB for FY82 revealed that approximately 7% of these personnel were from eight other commands (AAG, ADZ, AFR, CMS, ELM, LCT, NGS, and OSI) for which costs are not reported in the H069R data used by VAMOSC. Desmatics recommends that the Office of VAMOSC determine whether any significant PEC xxx96 costs are reported by commands other than the eleven represented in the ABDS data currently used. If so, steps should be taken to obtain this additional cost data for processing BOS in the C-E system. The same holds true, of course, for RPM and COM costs.

### 3. Removal of Some PEC xxx96 Costs

Desmatics recommends removing certain costs reported in PEC xxx96 from total BOS costs because they are included in other categories (where they properly belong) or are not considered an O&S cost by the C-E system. These costs, each of which can be identified by an RC/CC code [14] are listed below:

<u>RC/CC</u>	<u>Cost</u>
1. xx465x	Operation of bachelor housing
2. xx467x	Food Service
3. xx468x	Linen exchange
4. xx494x	Dependents' education services
5. xx8101	Civilian PCS (Permanent Change of Station) moves.

Costs for operation of bachelor housing (RC/CC xx465x), food service (RC/CC xx467x), and linen exchange (RC/CC xx468x) are currently accounted for as basic allowance for quarters and subsistence costs in the standard composite pay rates used to compute personnel expenses [11]. Selection of these costs for BOS therefore amounts to double-costing of these services.

Dependents' education services are not currently considered an O&S cost in the C-E system. Although costs for such services are not normally reported in the H069R data used by VAMOSC, Desmatics found some such cost records (PEC xxx96, RC/CC xx494x) in the TAC ABDS BOS data for FY81. These costs were incurred on behalf of two dependents' schools, one at England AFB, LA, the other at Myrtle Beach AFB, SC.

It is Desmatics' opinion that dependents' education costs should be included in the C-E system as an indirect personnel benefit for both mission and support personnel. For support personnel such costs should be included in Installation Support along with their direct costs. However, ABDS records coded PEC xxx96 with RC/CC xx494x only represent a small portion of the cost of dependents' education services to the Air Force. In addition they would include support for both mission and support personnel. Desmatics therefore recommends bypassing these records in processing BOS costs for C-E. Desmatics' proposed methodology for including dependents' education services for support personnel is presented in Section VII.

Costs for civilian PCS (Permanent Change of Station) moves are also reported in the H069R BOS data used by VAMOSC (PEC xxx96, RC/CC xx8101). Since these records represent costs for both supported and support personnel, and cannot be specifically identified to either group, Desmatics recommends excluding such records in the selection of BOS costs. However, as with dependents' education services, Desmatics contends that PCS costs for both military and civilian support personnel do need to be accounted for in Installation Support. A method for including these costs is outlined in Section VII.

#### 4. Allocation of BOS Costs to End Items

As discussed in Section III, it is Desmatics' opinion that the unit TMS allocation factor is inappropriate for distributing BOS costs to C-E end items. Since BOS services are primarily for the support of

personnel, an allocation based on personnel strengths is more appropriate for these costs. Desmatics has developed a revised version of the C-E FY82 BOS algorithm based on this principle which results in a one step allocation to end items at the worldwide level. It incorporates all the changes recommended in the previous subsections for the BOS personnel and cost data. It also makes use of the worldwide allocated administrative, operations, and maintenance personnel strengths for each TMS. The methodology for obtaining these allocated personnel strengths for display on the C-E O&S cost reports was outlined in Volume I of this series [19].

Briefly, operations personnel strengths at each organization are allocated using the Operator factors for that organization; these allocated strengths are then summed to the worldwide level for each TMS. Base labor (maintenance) personnel strengths are summed by AFSC worldwide then allocated to the appropriate TMSs using Base Labor Allocation factors. Administrative (including supply support) personnel strengths are allocated based on relative operations and maintenance personnel strengths. The equation for the revised algorithm for BOS costs for any TMS<sub>i</sub> is:

$$bos_i = \frac{C_r}{N_s} (O_i + M_i + A_i)$$



where  $\text{bos}_i$  = worldwide allocated BOS costs for any  $\text{TMS}_i$ ,

$C_r$  = revised worldwide BOS costs for C-E (Total of all PEC xxx96 records less those with RC/CCs xx465x, xx467x, xx468x, xx494x, and xx8101, from H069R, plus those indirect personnel benefits for BOS personnel, computed as described in Section VII.)

$N_s$  = number of supported personnel for C-E BOS (see Section IV.1),

$O_i$  = number of allocated operations personnel strengths for  $\text{TMS}_i$  worldwide [19],

$M_i$  = number of allocated maintenance personnel strengths for  $\text{TMS}_i$  worldwide [19],

and  $A_i$  = number of allocated administrative personnel strengths for  $\text{TMS}_i$  worldwide [19].

## V. REAL PROPERTY MAINTENANCE

As defined in AFR 400-31, Volume III [17], Real Property Maintenance (RPM) costs for each TMS include the costs for resources specifically identified and measurable to civil engineers and civil engineering squadrons for services related to the operation and maintenance of real property facilities. The costs for these services are defined as RPM costs if they are chargeable to Program Element Code (PEC) xxx94 [13].

### A. PROCESS DESCRIPTION

The following process description, taken from AFR 400-31, Volume III [17], pertains to the FY81 algorithm for developing RPM costs. The algorithm was changed for FY82, as will be discussed later in this section. In the first step in this FY81 process, the real property maintenance costs attributable to C-E facilities at a base are given by:

$$r_{C-Eb} = (m_{mpb} \times t_{mpb}) + (m_{ob} \times t_{ob})$$

where  $r_{C-Eb}$  = real property maintenance costs attributable to C-E facilities at a particular base,

$m_{mpb}$  = real property maintenance costs for maintenance and production buildings, at a particular base (GELOC) supporting a C-E facility (from F006, cost account code 51015),

$t_{mpb}$  = Air Force wide factor indicating the percentage of maintenance and production building RPM costs attributable to C-E facilities at the base (developed annually by AFESC/DEMG),

$m_{ob}$  = real property maintenance costs for "other" buildings at the base supporting the C-E facility (from F006, cost account code 51070),

and  $t_{ob}$  = Air Force wide factor indicating the percentage "other" building RPM costs attributable to C-E facilities at the base (from AFESC/DEMG).

The real property maintenance cost for a C-E end item,  $TMS_i$ , at each C-E facility at that location is given by:

$$R_{ib} = r_{C-Eb} \times f_{TMS_{ib}}$$

where  $R_{ib}$  = RPM cost for  $TMS_i$  at an organization at a particular location (GELOC),

and  $f_{TMS_{ib}}$  = unit TMS allocation factor for  $TMS_i$  at the organization (discussed previously in Section III).

The total Air Force wide RPM costs for  $TMS_i$ ,  $R_i$ , are then obtained by summing the RPM costs for all organizations owning the TMS:

$$R_i = \sum_b R_{ib}$$

For FY82 a new factor for allocating base level RPM costs to C-E facilities was developed by the Office of VAMOSC to replace  $m_{mpb}$  and  $t_{ob}$ . It is defined as the "value of an organization's equipment compared to the value of all equipment on base" [ 6 ]. For a given C-E organization at a base (where base is defined by SRAN or Stock Record Account Number) the equation for this factor is:

$$f_{rpm} = \frac{\sum_i Q_i \times P_i}{\sum_i Q_i \times P_i}$$

where  $f_{rpm}$  = RPM factor for a C-E organization at a given base (SRAN),  
 $Q_i$  = quantity of a given item at the organization (from D039),  
 $P_i$  = price of the item (from D039),  
 $n$  = number of different items at the organization,  
and  $N$  = number of different items at the base (SRAN).

According to the flow chart for Work Unit YF in the C-E System Specification [5], the Assets by Organization File is used for the computation of RPM factors. This file is built from D039 Format 100 and Format 50 records and contains only assets with C-E FSCs. The factors are applied to the total RPM costs selected as in the FY81 process ( $m_{mpb} + m_{ob}$ ) from F006 data. This cost data, as noted before is reported by GELOC. As before, C-E facility costs are allocated to C-E end items using unit TMS allocation factors. These allocated costs are then summed over all organizations worldwide for each TMS.

#### B. EVALUATION

The only difference between the algorithm used for C-E RPM costs for FY81 and that used for FY82 is in the factor used to allocate total base level RPM costs to C-E organizations prior to allocating these costs to end items. Desmatics was not furnished with any information on the FY81 factor and, therefore, cannot comment on its validity. The following discussions pertain to the processing for FY82.

## 1. FY82 RPM Factors

The numerators of the FY82 RPM factors are identical to the denominators of the unit TMS allocation factors for any given organization. These factors can therefore be combined into a single factor. This will reduce the allocation of RPM costs to individual end items at the organizational level to a one-step process. In this new factor the numerator represents the value of a TMS within a given organization and the demonimator represents the value of all equipment at the SRAN of the organization.

It should be noted that as in the case of the unit TMS allocation factor (see Section III), the current RPM factors contain only C-E asset data in both numerators and denominators. This causes overstatement of RPM costs for C-E end items. If the Office of VAMOSC continues to use these factors, the denominators should be expanded to include data for all organizational assets reported in the D039 system, not just those with C-E FSCs.

These RPM factors are not required in the alternate method proposed by Desmatics for computing RPM costs in the C-E system. This method is discussed in detail later in this section.

## 2. Cost Data for RPM

The data selected from the F006 system for this algorithm does not encompass all the costs listed in the C-E definition of RPM services. Cost account codes (CACs) from the 51000 series are for maintenance and

minor construction costs only; CAC 51015 is for reporting maintenance costs for Maintenance and Production buildings, and CAC 51070 is for reporting these same costs for Other (Permanent, Semi-Permanent, and Temporary) Buildings [10]. These two CACs, 51015 and 51070, are the only ones selected by C-E for RPM costs.

To include all the various costs listed for RPM in AFR 400-31, Volume III [17] and as defined by PEC xxx94 [13], the Office of VAMOSC would have to include costs from most accounts in the F006 data system. The entire list of these accounts would have to be examined in order to determine which should be bypassed in selecting RPM costs. Two prominent examples of irrelevant accounts are those for the operation and maintenance of military family housing and medical buildings [17].

Most cost data in the F006 system is reported under the Control Installation Code (GELOC) of the civil engineering organization providing the support. Various types of host/tenant and off-base installation support agreements exist for which the cost reporting rules differ. Depending on the type of agreement, costs for supported organizations may or may not be separately identifiable [9]. Desmatics has been unable to determine whether all such relationships which affect the C-E system have been clearly defined and fully accounted for in processing these RPM costs.

As noted previously, the RPM cost data from F006 is reported and selected by GELOC; the FY82 RPM factors, however, are developed from D039 asset data accumulated to the SRAN (Stock Record Account Number) level. A GELOC is not necessarily equivalent to a SRAN. In fact, GELOCs frequently encompass multiple SRANs, and also can include

multiple C-E organizations. To avoid misallocation the cost and asset data must correspond or be aggregated to the same level prior to any distribution of the costs.

In view of the fact that there is currently no automatic interface with the F006 data system, acquiring complete RPM cost data from this source will not be a simple matter. It appears, as well, that determining which costs should be selected will involve a considerable amount of effort. This is necessary not only to ensure that the selected data is complete, but also to verify that none of it duplicates data selected for other cost categories from other sources.

Desmatics recommends that the Office of VAMOSC use ABDS (H069R) as the data source for RPM costs in the C-E system. In this system RPM costs are reported under PEC xxx94, and, in fact, the C-E system actually defines RPM as the costs reported under this PEC [17]. The C-E system already uses H069R data for BOS and COM costs and the additional data for RPM is readily available to C-E (via the VAMOH preprocessor system).

Desmatics has developed an alternate algorithm for computing RPM costs for the C-E system. This new method, which uses H069R cost data, is similar to those recommended for BOS and COM costs (Sections IV and VI respectively). It is discussed in detail in the next subsection.

### 3. Alternate Method - C-E RPM Costs

Desmatics has developed an alternate method (similar to that recommended for BOS) for determining RPM costs in the C-E system. This method avoids many of the difficulties associated with

the current method. It also avoids allocating these costs to end items using ratios based on relative equipment value. In Desmatics' opinion, ratios based on equipment values are inappropriate for this category.

As mentioned previously, Desmatics recommends using data from the H069R system (ABDS) for RPM costs. These are identified by PEC xxx94. The first step is to sum these PEC xxx94 costs worldwide, bypassing, however, those records with RC/CCs xx4432 or xx4433 (repairs to family housing or medical facilities [14]). These costs are accounted for elsewhere in the C-E system (in quarters allowances in the standard composite pay rates and in the medical factor used to compute health care costs).

Desmatics also recommends adding, for RPM personnel, those indirect personnel benefits which are not already included under PEC xxx94. This topic is discussed in depth in Section VII. All these benefits can be computed using the methodology described in that section.

The allocation algorithm for RPM costs for any given  $TMS_i$  can be stated as:

$$r_i = \frac{R}{N_S} (O_i + M_i + A_i)$$

where  $r_i$  = worldwide allocated RPM costs for  $TMS_i$ ,

and  $R$  = worldwide RPM costs for the C-E system, from ABDS,  
all PEC xxx94 records except those with RC/CCs  
xx4432 or xx4433, plus indirect personnel benefits  
for RPM personnel computed as described in Section VII.

The variables  $N_S$ ,  $O_i$ ,  $M_i$  and  $A_i$  are defined as in Section IV. It should be noted that  $r_i$  in this method will also include those electric



utilities costs reported under Unit Level Consumption [17]. For reporting RPM costs, these electric utilities costs should be eliminated by subtracting the worldwide allocated electric utilities costs from the worldwide allocated RPM costs for each TMS. Thus, defining these adjusted worldwide RPM costs for any  $TMS_i$  as  $r'_i$ , they would be computed as follows:

$$r'_i = r_i - u_i$$

where  $r_i$  = worldwide allocated RPM costs for  $TMS_i$ ,

and  $u_i$  = worldwide allocated electric utilities costs for  $TMS_i$ .

For any  $TMS_i$  this revised RPM cost ( $r'_i$ ) is the one which should be displayed on the O&S Cost Report for this cost category.

## VI. COMMUNICATIONS

According to AFR 400-31, Volume III [17], the communications support cost for each end item consists of two elements: command communications and base communications. The C-E algorithm for this category is used to allocate base communications cost. The term "communications cost," as used in this volume, will refer to base communications cost only, unless otherwise specified. The C-E system's definition of Communications cost will be discussed further in this section.

### A. PROCESS DESCRIPTION

The following description is based on the algorithm as outlined in AFR 400-31, Volume III [17]. Many aspects of the process presented in that document have been changed or eliminated. However, no documentation of these changes was available to Desmatics at the time of this writing. Those areas of the process which are ill-defined will be pointed out as they arise. The following algorithm was used in both FY81 and FY82 processing.

The VAMOH preprocessor selects H069R system interface accounting records with a PEC of xxx95 or records with a PEC of 33112 and RC/CCs of xx26xx or xx38xx. These selected records are then passed to the D160A system in the C-E Accounting System for Operations File. By using the OAC/OBAN contained on the selected cost records and an internal supporting OAC/OBAN-supported OAC/OBAN table, the D160A system attempts to

relate communications costs for a base (identified as a supporting organization in the table) to the C-E organizations supported by the base. These relationships are based on data collected on the C-E Unit Level Report (RCS: HAF-LEY(A)8119).

These base communications costs are first allocated to a supported organization, and then to the C-E end items at the organization. To allocate costs to the supported organization level, the D160A system develops the Base Communications Factor (which for the sake of brevity will be referred to henceforth as the BCF), based on information collected by the Office of VAMOSC on the Unit Level Report. The formula for this factor, as described in AFR 400-31, Volume III [17], is:

$$F_{BCO} = \frac{ClA_o}{ClA_B} (W_{Cl-A}) + \frac{ClC_o}{ClC_B} (W_{Cl-C}) + \frac{R_o}{R_B} (W_R) + M_r (W_m) \quad (1)$$

where  $F_{BCO}$  = the BCF for organization o,

$ClA_o$  = number of Class A telephone lines assigned to organization o (from Unit Level Reports),

$ClA_B$  = total number of Class A telephone lines at the base supporting the C-E organization (from Unit Level Reports),

$W_{Cl-A}$  = weighting factor for Class A telephone service. This factor represents the Class A telephone portion of total base communications costs at a base (Class A and C telephone service, nontactical radios, and message centers), as supplied by HQ AFCC,

( $ClC_o$ ,  $ClC_B$ ,  $W_{Cl-C}$ , are the corresponding quantities for Class C telephone service,)

$R_o$  = number of nontactical radios assigned to organization o (from Unit Level Reports),

$R_B$  = number of nontactical radios at the base supporting the C-E organization (from Unit Level Reports),

$W_R$  = weighting factor for nontactical radios (from HQ AFCC),

$M_r$  = ratio of the message traffic supporting the C-E organization to total message traffic for base supporting the C-E organization (from Unit Level Reports),

and  $W_m$  = weighting factor for message traffic (from HQ AFCC).

Class A telephone service is for transaction of official business with access to all facilities, including long distance, at government expense. Class C telephone service is also for transaction of official business; however, it is restricted to intra-base communications, with no access to long distance [8].

It should be noted that the weighting factors were unavailable from HQ AFCC for FY81 and FY82 processing. In addition, Desmatics was unable to determine what weights were substituted by the Office of VAMOSC. Also, the percentage of nontactical radios on the base assigned to the C-E organization was collected in FY82, rather than the values indicated in the formula above. Because of these differences from the published description of the BCF, it is apparent that some other process was used to compute them. The actual process used for computing the BCFs was unknown to Desmatics at the time of this writing. The Office of VAMOSC was unable to provide any description of the computation of these factors. As a result, Desmatics put considerable effort into an examination of FY82 Unit Level Reports, and a comparison of the data on those reports with the BCFs reported in the C-E FY82 Unit Factor Table. Numerous attempts by Desmatics to reproduce those BCFs from the raw

data, in the absence of this description, failed to reveal how the BCFs were derived.

The communications costs for a base are allocated to the supported organization level by multiplying them by the organization's BCF. The costs are then further allocated to the TMS level. This is accomplished with the unit TMS allocation factor ( $f_{TMS}$ ). This factor is described in Section III. These TMS-level costs are added for all occurrences of the TMS to give the worldwide communications cost for the TMS.

## B. EVALUATION

The following subsections evaluate several aspects of the C-E Communications cost algorithm. An evaluation of the TMS allocation Factor used in this algorithm is given in Section III.

### 1. Communications Cost Clarification

As mentioned earlier, AFR 400-31, Volume III [17] provides a definition of Communications cost which consists of the subelements command communications and base communications. The C-E cost algorithm, however, allocates the costs of base communications. The Cost Analysis Improvement Group (CAIG) guidelines for O&S costing indicate that command-level costs are to be excluded from analysis [2]. Therefore, the C-E system is allocating the correct subelement of this cost.

In light of this dissimilarity of definition and algorithm, the current definition and title of this cost category in AFR 400-31, Volume

III, and the line item on the O&S Cost Report ("Communications") may be confusing. The true coverage of this cost category, base communications, is obscured. Desmatics recommends two changes which should better present the true scope of these costs to a user. First, the definition given in AFR 400-31, Volume III for this category should be rewritten to refer only to Base Communications. The second change is to retitl the line item on the O&S Cost Report as "Base Communications." These changes will explicitly delineate the costs which are reported in this category.

## 2. Mathematical Discussion of the BCF

Any allocation ratio should have the property of consistency [4]. An allocation ratio is said to be consistent when the parameters in the ratio are incorporated in such a way that comparisons of the relationship of two organizations, TMSs, etc. are stable and not dependent on the parameters of a third organization, TMS, etc.. The current formulation of the BCF does not have this property and may be termed "inconsistent." This characteristic is illustrated in Figure 1. For this example, it was assumed that each of the elements in the BCF formula were weighted equally (i.e., each of the four elements had weight .25). However, the conclusions reached hold for any legitimate weight values. As depicted in Figure 1, the data for the organizations 1 and 2 at a base remain the same in all three cases, with parameters changing only for organization 3. Since organization 1 has not changed relative to organization 2, the ratio of the allocated cost for organi-

Total Costs to be Allocated: \$20,000

	Class A	Class C	Tac. Radios	Messages	BCF	Allocated \$	
Organization #1	10	10	3	100	.1940	3880	R=1.537 *
Organization #2	5	10	2	50	.1262	2524	
Organization #3	<u>35</u>	<u>55</u>	<u>5</u>	<u>550</u>	<u>.6798</u>	<u>13596</u>	
Base Total	50	75	10	700		20000	
Organization #1	10	10	3	100	.1788	3576	R=1.457 *
Organization #2	5	10	2	50	.1227	2454	
Organization #3	<u>60</u>	<u>30</u>	<u>10</u>	<u>400</u>	<u>.6985</u>	<u>13970</u>	
Base Total	75	50	15	550		20000	
Organization #1	10	10	3	100	.3616	7232	R=1.558 *
Organization #2	5	10	2	50	.2321	4642	
Organization #3	<u>5</u>	<u>15</u>	<u>3</u>	<u>200</u>	<u>.4063</u>	<u>8126</u>	
Base Total	20	35	8	350		20000	

\*Denotes ratio of organization #1 allocated costs to Organization #2 allocated costs using BCF formulation (1) presented in the text and in AFR 400-31, Volume III [17].

Figure 1: Hypothetical Allocation of Cost with Inconsistent BCF

zation 1 to that for organization 2, R, should remain the same. However, it may be easily seen that, for the current allocation, this ratio is affected by changes in the characteristics of the third organization, and is therefore inconsistent.

In order to provide a consistent allocation, the following formulation of the BCF would be necessary:

$$F_{BCO} = \frac{\alpha ClA_O + \beta ClC_O + \gamma R_O + \delta M_O}{\alpha ClA_B + \beta ClC_B + \gamma R_B + \delta M_B} \quad (2)$$

where  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\delta$  are weighting factors to be determined,

$F_{BCO}$ ,  $ClA_O$ ,  $ClC_O$ ,  $R_O$ ,  $ClA_B$ ,  $ClC_B$ ,  $R_B$  are as defined in (1),

and  $M_O$  and  $M_B$  are message traffic for the organization and for the supporting base, respectively.

The relationship for the weighting factors is:  $\alpha + \beta + \gamma + \delta = 1$ .

Note also that  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\delta \geq 0$ . An example (using arbitrary values of  $\alpha=\beta=\gamma=\delta=.25$ ) illustrating the consistency of this ratio is given in Figure 2. It can be seen that the ratio between organization 1 and 2 remains stable and is not dependent on changes to other organizations. It is therefore a "consistent" allocation ratio.

The values of the weighting factors may be estimated using linear regression. The procedure would consist of regressing the communications cost (PEC xxx95, and PEC 33112 with RC/CC xx26xx or xx38xx) by supporting OAC/OBAN versus the total number of Class A lines, Class C lines, messages, and nontactical radios at all organizations supported by that OAC/OBAN. This can be done over all supporting OAC/OBANs with one year of data to produce AF-wide weighting factors; with at least four years of data,



Total Costs to be Allocated: \$20,000

	Class A	Class C	Tac. Radios	Messages	BCF	Allocated \$	
Organization #1	10	10	3	100	.1473	2946	R=1.836 *
Organization #2	5	10	2	50	.0802	1604	
Organization #3	<u>35</u>	<u>55</u>	<u>5</u>	<u>550</u>	.7725	<u>15450</u>	
Base Total	50	75	10	700		20000	
Organization #1	10	10	3	100	.1783	3566	R=1.836 *
Organization #2	5	10	2	50	.0971	1942	
Organization #3	<u>60</u>	<u>30</u>	<u>10</u>	<u>400</u>	.7246	<u>14492</u>	
Base Total	75	50	15	550		20000	
Organization #1	10	10	3	100	.2978	5956	R=1.836 *
Organization #2	5	10	2	50	.1622	3244	
Organization #3	<u>5</u>	<u>15</u>	<u>3</u>	<u>200</u>	.5400	<u>10800</u>	
Base Total	20	35	8	350		20000	

\*Denotes ratio of Organization #1 allocated costs to Organization #2 allocated costs using consistent BCF ratio presented in text.

Figure 2: Hypothetical Allocation of Costs with a Consistent BCF

OAC/OBAN-level weighting factors are possible [4]. Much of the data needed to use the consistent BCF is collected on the C-E Unit Level Report. However, the current report collects percentages of nontactical radios and message traffic by organization within base, when what is needed to apply equation (2) are the actual numbers of messages and nontactical radios, by base and organization. Obviously, this should not be any more difficult to obtain, since these figures are used to compute the percentages currently collected.

Although it would appear desirable to collect the data necessary to construct these new consistent ratios, there are several reasons why this may not be warranted. Desmatics has examined the communications data portion of the FY82 C-E Unit Level Report. Based on this data, correlation coefficients for the variables used in the current BCF were computed for 86 randomly chosen organizations of the 618 organizations represented in the FY82 C-E Unit Factor Table (see Figure 3). Several of these variables were shown to be highly positively correlated, particularly the Class A and Class C line values (i.e., the ratios of Class A or Class C lines at an organization to those on the base).

An examination of Figure 3 indicates the nearly perfect correlation ( $r=.9744$ ) of the Class A and Class C variables. In addition, Class A and Class C are also correlated with the message traffic variable ( $r=.53410$  and  $r=.53151$ , respectively). Each of the correlations mentioned are highly significant, as indicated by the significance level below the correlation value in the figure. (Nontactical radios, while not highly correlated with the other variables, appear from the data to represent a very small portion of the communications activity for the

	$\frac{CIC_o}{CIC_B}$	$M_r$	$\frac{R_o}{R_B}$
$\frac{CIA_o}{CIA_B}$	0.97444 (0.0001)	0.53410 (0.0001)	0.10666 (0.3284)
$\frac{CIC_o}{CIC_B}$		0.53151 (0.0001)	0.07088 (0.5166)
$M_r$			0.07259 (0.5066)

Note: The top number in each cell indicates the correlation coefficient. The bottom number indicates the significance level of the coefficient (i.e., the probability of obtaining this large or a larger value if, in fact, there actually were no true correlation between the variables). Those significance levels  $\leq .01$  are usually termed "highly significant."

Figure 3: Correlation Coefficients for 86 organizations, Based on FY82 Unit Level Report Data

organizations reporting.)

This high correlation between variables, or collinearity, presents some problems for the BCF. First, little additional independent information is gained about the cost drivers (the items in the BCF) when these variables are used. Furthermore, when one attempts to derive the weighting factors for the BCF with a regression procedure as described above, spurious weights can result [1]. Although procedures exist to attempt to correct this situation, in Desmatics' opinion it is more desirable to locate another means of allocating the Base Communications costs. The reasons underlying this statement, and a discussion of an alternate allocation algorithm are discussed later.

### 3. Rounding Error in Allocation

The record layout for the Unit Factor Table Input Transaction in the C-E System Specification [5] indicates a three character field for the Base Communications Factor. This field is constructed such that there are two digits to the right of the decimal point in the value of the BCF. The smallest positive number which can be represented in this field is .01. This presents a serious rounding error problem for the Communications Cost algorithm.

Most (437 of 618 or 71%) of the BCFs in the FY82 Unit Factor Table are reported as .01. From an examination of the Unit Factor Table, it is apparent that the rounding rule used for these BCFs was that a computed BCF between .005 and .015 would be reported as .01 (this is a common rounding scheme). Such a rounding process introduces errors of this form:

$$\text{Absolute Error} = (\text{reported BCF} - \text{computed BCF}) \cdot C_{\text{ASO}}$$

where  $C_{\text{ASO}}$  = the communications cost for a supporting OAC/OBAN (PEC xxx95, and PEC 33112 with RC/CC xx26xx or xx38xx).

Consider a situation in which  $C_{\text{ASO}} = \$1,000,000$ , reported BCF = .01, and the computed BCF = .01475. From the above formula it can be seen that the error introduced by rounding .01475 to .01 is -\$4750. In relative terms, this corresponds to an error of -32.2%:

$$\begin{aligned} \text{Relative Error} &= [(\text{reported BCF} - \text{computed BCF}) / \text{computed BCF}] \cdot 100 \\ &= [(.01 - .01475) / .01475] \cdot 100 \\ &= -32.2 \end{aligned}$$

By adding one more decimal place to the BCF field, the maximum absolute rounding error is reduced from  $.005C_{\text{ASO}}$  to  $.0005C_{\text{ASO}}$ , and adding two more digits reduces the maximum absolute rounding error to  $.00005C_{\text{ASO}}$ . Of course, the relative errors also decrease. Even though allocation factors may be considered rough, it is incorrect to introduce large rounding errors. For this reason, Desmatics recommends that allocation factors in the C-E system be permitted more digits (preferably  $\geq 4$ ) to the right of the decimal point. Currently the following factors have less than four decimal digits: Fuel factor (2 digits), Operator factor (2), Base Communications factor (2), and Base Operations factor (2).

#### 4. An Alternative Algorithm

As mentioned in the preceding subsections, there are several

mathematical inadequacies in the present formulation of the BCF. In addition, in Desmatics' opinion, the allocation factor,  $f_{TMS}$ , currently used to allocate costs to the TMS level is inappropriate for the allocation of communications cost, as was presented in Section III. Also, difficulties can arise with the matching of supporting and reporting OAC/OBANs, as illustrated by the example in Section IV. Finally, there is the rather large manual task of producing, distributing, and analyzing Unit Level Reports to gather data for use in constructing the BCFs.

In order that the C-E system avoid these problems, Desmatics recommends that the following algorithm replace the current Communications Cost algorithm:

$$C_{BC_i} = \frac{C_{BCW}}{N_S} \times (O_i + M_i + A_i)$$

where  $C_{BC_i}$  = the Base Communications Cost allocated to  $TMS_i$ ,

$C_{BCW}$  = the worldwide Base Communications Cost (PEC xxx95, and PEC 33112 with RC/CC xx26xx or xx38xx, all OAC/OBANs in C-E ASO Extract),

$N_S$  = the worldwide number of personnel supported (see below),

and  $O_i + M_i + A_i$  = the number of unit mission personnel allocated to  $TMS_i$  (see below).

This algorithm is analogous to the revised algorithms recommended by Desmatics for BOS and RPM costs. Those algorithms are explained in earlier sections (IV and V, respectively) of this volume.

A more detailed explanation of the terms in this suggested algorithm follows. The cost  $C_{BCW}$  is composed of the same PECs as in the current C-E allocation. However, the costs are added to the worldwide level and allocated downward in this new process. This avoids the need to identify supporting/reporting OAC/OBAN relationships.

Next, consider the term  $N_S$ . This is used to compute a base communications cost per supported person and is the same quantity as in the BOS and RPM algorithms. The term  $N_S$  is computed thusly:

$$N_S = N_W - N_B - N_R - N_M$$

where  $N_S$  = the worldwide number of personnel supported,

$N_W$  = total number of personnel (military and civilian) from the VAMOH Consolidated MPC file (see also Section IV),

$N_B$  = number of personnel in Consolidated MPC file having PEC xxx96 (BOS),

$N_R$  = total number of personnel in Consolidated MPC file having PEC xxx94 (RPM),

and  $N_M$  = total number of personnel in Consolidated MPC file having FAC 5xxx, not already removed by  $N_B$ , or  $N_R$ .

The final term in the new algorithm is  $(O_i + M_i + A_i)$ . This represents the number of unit mission personnel associated with a TMS, as allocated by the C-E unit mission personnel algorithms. This is the worldwide sum, for a TMS, of the allocated Operations Personnel, Base Maintenance Personnel, and Administrative Personnel (which is to also include Supply Support Personnel, see [19]). Unit mission personnel can be allocated to a TMS using the same allocation factors as are used to allocate the corresponding personnel costs [19]. It should be

noted that this algorithm is formulated such that it is "consistent" in its allocation.

The costs allocated by this algorithm have a special status in that they are jointly mission-oriented and support-oriented. As an item of C-E equipment, a telephone switchboard has a mission. At the same time this switchboard is supporting other missions. As such this algorithm is double-costing to a certain extent, as the costs in the PECs involved may be allocated to an item as a direct mission expense, and a portion of that is reallocated to the item as communications support. Desmatics considers this to be a small problem. However when one wants to determine the total expenditures for all costs across all TMSs, Communications should be omitted from this grand total since it will be subsumed in other direct costs.



## VII. INDIRECT PERSONNEL COSTS-SUPPORT PERSONNEL

The C-E system currently provides separate visibility for the following indirect personnel costs for unit mission personnel: medical (health care) (for military personnel), TDY (Temporary Duty), and PCS. Desmatics recommends expanding this list of benefits to include retirement, unfunded civilian personnel benefits, medical care for dependents of military personnel, and dependents' education services. This topic, as it relates to unit mission personnel, will be discussed in depth in Volume V of this series (Indirect Personnel).

In Desmatics' opinion all indirect personnel costs (listed above) for support personnel should be included in Installation Support along with their direct costs. These indirect personnel benefits for support personnel constitute legitimate O&S costs and should be allocated to C-E end items.

Some indirect personnel costs for support personnel are embedded in H069R Installation Support cost data (PECs xxx94, xxx95, xxx96 or PEC 33112 with RC/CCs xx38xx or xx26xx), some are not. Desmatics has determined that those costs which need to be added to Installation Support for BOS, RPM, and COM to incorporate all indirect personnel costs for these personnel are:

1. medical costs for military support personnel and their dependents,
2. military support personnel retirement costs,
3. unfunded benefits, civilian support personnel,
4. dependents' education costs,
- and 5. PCS costs.

Computation of each of these costs for the three subcategories of Installation Support personnel is discussed in separate subsections below.

#### 1. Medical Care

The VAMOSC system currently computes medical (health care) costs by applying a Medical Cost Factor (average medical cost per military person) [17,20], to counts of military personnel strengths. This factor is computed and supplied annually to the Office of VAMOSC by the Office of the Surgeon General (HQ USAF/SGMC). Desmatics previously recommended (for the WSSC system) that this factor be expanded to incorporate medical benefits for dependents of active duty personnel; this change is scheduled to be completed for FY84 [20].

Medical costs for BOS military personnel (and their dependents) can be calculated as follows:

- (1) Count the number of military personnel with a PEC of xxx96 in the MPC Consolidated Personnel File, bypassing those records with the following FACs: 4650, 4670, 4680, 4940 and 5xxx (See Section VIII).
- (2) Multiply these counts by the revised Medical Cost Factor [20] to get worldwide BOS costs for military personnel and their dependents.
- (3) Add these medical costs to the total BOS costs, determined as described in Section IV.

For RPM personnel, the counts will include all PEC xxx94 records in this MPC File except for those with FACs 5xxx, 4442, and 4443. It should be noted that FACs 4442 and 4443 are only for supervisory per-

sonnel for family housing and medical facility maintenance. Other personnel involved with RPM generally cannot be specifically identified to a particular type of facility. Personnel counts for COM personnel are identifiable by PEC xxx95 (except FAC 5xxx) or PEC 33112 with a FAC of 38xx or 26xx. The medical costs for RPM and COM personnel are added to total RPM and COM costs respectively, determined as described in Sections V and VI.

## 2. Military Retirement

All military retirement in the Air Force is unfunded. Retirement costs for military BOS personnel can be developed by applying the acceleration factor for this benefit (26.5%) [15] (this factor, it should be noted, is updated periodically) to the standard composite pay rate for these personnel. Computations are as follows:

- (1) When summing total BOS costs, separately sum those PEC xxx96 costs with an EEIC (Element of Expense/Investment Account) of 20xxx (military pay) [11], bypassing records with RC/CCs xx465x, xx467x, xx468x, and xx494x.
- (2) Multiply these military pay costs by the retirement acceleration factor [13] and add this product to total BOS costs, determined as described in Section IV.

The corresponding RPM costs to which the retirement factor should be applied are the sum of all costs for H069R PEC xxx94 records with an EEIC of 20xxx unless also coded with an RC/CC of xx4432 or xx4433. Similarly, for COM personnel, these EEIC 20xxx costs would be summed over all H069R records with PEC xxx95, and PEC 33112 with RC/CCs of xx38xx or 26xx. As before, these computed retirement costs would be added to the appropriate total RPM or COM costs (Sections V and VI

respectively).

### 3. Unfunded Civilian Benefits

A portion of civilian benefits is funded by the Air Force; this portion is included in the composite pay rates used to compute pay and allowances [11,15] for these personnel. For civilian support personnel these benefits (which include the funded portion of their retirement) are included in the H069R data for Installation Support.

Unfunded portions of civilian personnel benefits are covered by DOD accounts. According to AFR 173-13 [15], funded benefits are 13.446% of civilian base pay, total (funded and unfunded) retirement benefits are 20.4%, and other benefits are 5.6%. Therefore the unfunded portion of these civilian benefits amounts to 12.554% ( $20.4 + 5.6 - 13.446 = 12.554$ ) of base pay. These unfunded benefits can be computed for civilian BOS personnel as follows:

- (1) Sum civilian BOS personnel base pay costs (H069R records with PEC xxx96 and EEIC 392xx (civilian base pay [11]), except for those with RC/CCs xx46x, xx467x, xx468x, or xx494x).
- (2) Multiply this sum by .12554, and add this product to total BOS costs, determined as described previously.

For RPM and COM civilian support personnel their corresponding H069R cost records should be selected, the unfunded benefits computed as above, and added to the total RPM and COM costs respectively.

### 4. Dependents' Education Services

The C-E system does not currently consider costs for dependents'

education as an allocable operating and support cost. Desmatics, however recommends that these benefits be included in the system.

Dependents' education costs in the United States are funded by the U.S. Office of Elementary and Secondary Education within the Department of Health and Human Services; overseas, these costs are funded by the Department of Defense. They represent expenses incurred on behalf of dependents of both military and civilian personnel. Although these costs are not available directly, they could be computed using an average cost factor similar to the medical care factor. A method for developing such a factor is described below.

For overseas areas the DOD computes factors for three broad geographical areas as well as a worldwide weighted average factor representing the average cost per student for the education of dependent children [3]. Desmatics recommends that the Office of VAMOSC obtain a list of overseas sites where dependents are authorized and use the average cost per (dependent) student to compute the total cost of dependents' education services for AF employees stationed overseas. This could be computed as follows:

$$E_o = F \times (C_o + M_o) \times n$$

where  $E_o$  = total cost of dependents' education services for Air Force employees stationed overseas,

$F$  = average cost per student for dependents' education services overseas [3],

$C_o$  = number of civilian AF personnel, grades of GS-7 and above, stationed at overseas sites where dependents are authorized,

$M_o$  = number of military AF personnel, grades O-2, W-1, E-5 and above, stationed at overseas sites where dependents are authorized,

and  $n$  = average number of school age dependents for the above grades of AF personnel overseas [3].

For dependents' education services in CONUS areas, Desmatics suggests that the Office of VAMOSC contact the Office of Secondary and Elementary Education regarding the availability of a similar cost per dependent or AF employee for CONUS areas, or the requisite data to develop such a factor. The total cost of dependents' education services in CONUS areas can then be computed in the same manner as was outlined for overseas areas. An education cost factor representing the average cost of dependents' education services per AF employee worldwide can then be developed. This computation would have to be done annually. The equation is:

$$e = \frac{E_o + E_c}{N}$$

where  $e$  = average cost of dependents' education services per AF employee worldwide,

$E_o$  = total cost of dependents' education services, overseas areas,

$E_c$  = total cost of dependents' education services, CONUS areas,

and  $N$  = total number of AF employees, worldwide.

Dependents' education benefits for support personnel can then be computed as follows:

1. Separately count military and civilian BOS, COM, and RPM personnel (as described previously, MPC Consolidated Personnel File).
2. Multiply these sums by the education cost factor described above.
3. Add the totals for BOS, RPM, and COM personnel to the respective total costs (Sections IV, V, and VI).

#### 5. PCS Costs

Permanent Change of Station costs for military personnel are computed by the VAMOH preprocessor system and included in the MPC Consolidated Personnel File [7]. The methodology for including these costs for (military) support personnel is as follows:

1. Separately sum PCS costs (computed by VAMOH [7]) over all BOS, RPM, and COM personnel records (Section VIII) in the MPC Consolidated Personnel File.
2. Add these sums to total BOS, COM, and RPM costs, respectively.

For civilian support personnel PCS costs are computed thusly:

1. Separately count all civilian BOS, RPM, and COM personnel (Section VIII) with a PCS move (MPC Consolidated Personnel File).
2. For each subcategory (BOS, RPM, COM) multiply the total counts by the average PCS cost factor (available in the DCA Cost and Planning Factors Manual [3]),
3. Sum the products and add the relevant totals to total BOS, RPM or COM costs, respectively.

### VIII. INSTALLATION SUPPORT STRENGTHS

To provide additional information and at the same time conform more closely to CAIG reporting guidelines [2], the C-E system should display allocated installation support strengths on the O&S cost reports. In accordance with CAIG, Desmatics recommends that the C-E system provide visibility of installation support strengths to the officer, enlisted, and civilian level.

Allocated BOS strengths can be determined using a modified version of the equation used for allocating BOS costs. This equation may be expressed as:

$$B_{ij} = \frac{N_{Bj}}{N_S} (O_i + M_i + A_i)$$

where  $B_{ij}$  = number of BOS personnel by type (officer, enlisted, civilian) allocated to  $TMS_i$  worldwide,

$N_S$  = number of supported personnel worldwide, developed as outlined earlier in this volume,

$O_i$  = number of allocated operations personnel for  $TMS_i$  worldwide (see [19]),

$M_i$  = number of allocated maintenance personnel for  $TMS_i$  worldwide (see [19]),

$A_i$  = number of allocated administrative personnel for  $TMS_i$  worldwide (see [19]),

$N_{Bj}$  = number of BOS officers, or BOS enlisted personnel, or BOS civilians; developed from VAMOH Consolidated MPC Extract, PEC xxx96 minus those personnel described below.

The term  $N_{Bj}$  will have three values, resulting from counts of BOS



personnel developed separately for officers, enlisted, and civilian personnel. As outlined in Section IV, several types of cost should be removed from the BOS category. The personnel associated with these costs should be removed from  $N_{Bj}$  in this algorithm. These personnel are as follows:

1. FAC 4650 - Billeting [12],
2. FAC 467x - Food Service [12],
3. FAC 4680 - Linen Exchange [12],
4. FAC 4940 - Dependents' School [12],
- and 5. FAC 5xxx - Medical personnel [12].

Personnel with these FACs should be subtracted from the count of PEC xxx96 personnel when they occur with that PEC.

The strengths for RPM are developed similarly:

$$R_{ij} = \frac{N_{Rj}}{N_S} (O_i + M_i + A_i)$$

where  $R_{ij}$  = number of RPM personnel by type (officer, enlisted, civilian) allocated to  $TMS_i$  worldwide,

$N_{Rj}$  = number of RPM officers, or RPM enlisted personnel, or RPM civilians; developed from VAMOH Consolidated MPC Extract, PEC xxx94, minus those personnel outlined below,

and  $N_S$ ,  $O_i$ ,  $M_i$ ,  $A_i$  are as defined above.

Since it is recommended to remove costs for the RPM services associated with medical and family housing buildings, it is also necessary to adjust the personnel in  $N_{Rj}$ . Personnel with the following FACs should be excluded from  $N_{Rj}$  when they occur with PEC xxx94:

1. FAC 4432 - Family Housing Maintenance-Supervision [12],
2. FAC 4433 - Medical Facility Maintenance-Supervision [12],
- and 3. FAC 5xxx - Medical Personnel [12].

It should be noted that FACs 4432 and 4433 only account for supervisory personnel. Workers associated with these two functions will be subsumed under FACs which are applicable to their particular skill.

Therefore, this removal of personnel in these two FACs is not going to remove all of the people who should be removed. However, since the other workers are not given visibility, Desmatics considers this to be a reasonable compromise.

Lastly, the strengths for Communications are given by:

$$C_{ij} = \frac{N_{Cj}}{N_S} (O_i + M_i + A_i)$$

where  $C_{ij}$  = number of communications personnel by type (officer, enlisted, civilian) allocated to  $TMS_i$  worldwide,

$N_{Cj}$  = number of communications officers, enlisted personnel, or civilians; developed from VAMOH Consolidated MPC Extract, PEC xxx95 (except FAC 5xxx) and PEC 33112 with FAC 26xx or 38xx,

and  $N_S$ ,  $O_i$ ,  $M_i$ ,  $A_i$  are as defined above.

These strengths should be portrayed on the C-E O&S Cost Report in a manner similar to that given in Figure 4. In order to accomplish this visibility of strengths, it is first necessary to implement Recommendation 4 in Desmatics Technical Report No. 118-1 [19], which deals with the development and portrayal of unit mission personnel strengths.

	Detail Cost	Category Subtotal	Officers	Enlisted	Civilian
Installation Support		XXXXX	XXXX	XXXX	XXXX
Base Operating Support	XXXXX		XXX	XXX	XXX
Real Property Maintenance	XXXXX		XXX	XXX	XXX
Base Communications	XXXXX		XXX	XXX	XXX

Figure 4: Recommended Portrayal of Installation Support  
Personnel Strengths on C-E Cost Report

## IX. CONCLUSIONS, RECOMMENDATIONS, AND OFFICE OF VAMOSC COMMENTS

This volume has presented an evaluation of the C-E cost allocation algorithms defined by the system as Installation Support: Base Operating Support (BOS), Real Property Maintenance (RPM), and Communications (COM). A fourth algorithm previously included in this category, Medical Care, is now included as a subcategory of Indirect Personnel costs.

The unit TMS allocation factor algorithm was also evaluated in this report. This factor is used to allocate organizational level costs to end items in an organization's inventory, not only in the three algorithms in Installation Support, but in several others as well.

### A. SUMMARY

In Desmatics' opinion the unit TMS allocation factor is inappropriate for allocating all three subcategories of Installation Support costs in the C-E system, and should be replaced by ratios based on personnel strengths. However, if the factor continues to be used in the C-E system, its denominator needs to be expanded to include all organizational assets, not just those with C-E FSCs. This will prevent overstatement of the costs being allocated, particularly for those end items at "non-C-E" organizations. The factor should also be redefined.

The FY82 method for processing BOS costs is a considerable improvement over the FY81 method. However, Desmatics recommends a number of

refinements to the data selection and allocation which will further improve the quality of this reported cost.

Numerous changes are required to improve the C-E system processing of RPM costs. In view of the difficulties associated with the implementation of these changes, however, Desmatics proposes using an alternate data source (H069R), and also recommends an allocation based on personnel strengths as being more relevant.

There are several mathematical problems with the Base Communications Factor, which is used in the C-E system to allocate Communications cost. Desmatics provides a revised algorithm, which overcomes the problems associated with the current Communications cost processing. This suggested algorithm also eliminates the requirement for the collection of unit level communications data.

Several of the algorithms used in the C-E system are subject to large rounding errors. This is due to the lack of sufficient precision in the allocation factors. Desmatics recommends that these factors carry additional decimal places to minimize this problem.

Desmatics recommends that the C-E system report installation support strengths on the C-E O&S Cost Report. This would provide additional information for the user and put C-E in compliance with CAIG guidelines in this area. Desmatics provides a methodology which will provide the strengths and recommends a possible reporting format for those numbers.

## B. RECOMMENDATIONS AND REPLIES

This section lists Desmatics' conclusions and recommendations regarding the C-E Installation Support algorithms. The responses or comments of the Office of VAMOSC are also included.

### 1. Unit TMS Allocation Factor (See pages 6,7)

Conclusion: The denominators of the unit TMS allocation factors only contain data for items with C-E FSCs. This causes overstatement of costs allocated by this factor, particularly for those C-E end items owned by "non-C-E" organizations.

Recommendation: If the Office of VAMOSC continues to use these factors, the denominators should be expanded to include all assets owned by the organizations which are reported on the D039 system Format 100 records, and the definition of the factor changed to reflect this.

Office of VAMOSC Comments: "Concur in principle. If the unit TMS allocation factor were to continue to be used, the denominator should be expanded to include all assets of organizations which own C-E equipment, whether those assets are C-E or non C-E. The unit TMS allocation factor, however, is not appropriate for allocating BOS, RPM, and COM costs per person, and should be replaced by the methodology suggested in recommendation No. 2 in this technical report."

## 2. Allocation of Installation Support Costs to End Items (See page 8)

Conclusion: The unit TMS allocation factor which is based on relative equipment value is inappropriate for the allocation of Installation Support (BOS, RPM, COM) costs in the C-E system.

Recommendation: The Office of VAMOSC should use the sum of the worldwide allocated administrative, operations, and maintenance personnel for a TMS to allocate a BOS cost per (supported) person (and similarly RPM and COM cost per (supported) person, computed as described in the text) to end items. The methodology for allocating these personnel strengths, which is outlined briefly in the text, is discussed in detail in Volume I [19] of this series.

Office of VAMOSC Comments: "Concur. The change will be implemented in FY87 pending implementation of the Vol I methodology to allocate BOS, RPM, and COM costs by personnel."

## 3. Removal of Support Personnel Strengths (See pages 13,14,40)

Conclusion: The portion of Installation Support (BOS, RPM, COM) resources consumed by support personnel should be allocated to C-E end items.

Recommendation: To allocate these costs, the Office of VAMOSC should remove support personnel strengths from the total number of Air Force personnel to compute a worldwide BOS (and similarly RPM and COM) cost per supported person for Desmatics' recommended algorithms for BOS, RPM and COM costs for C-E. These are BOS personnel (PEC xxx96), RPM personnel (PEC xxx94), and Medical personnel (FAC 5xxx).

Office of VAMOSC Comments: "The Office of VAMOSC concurs with the recommendation that installation support resources consumed by support personnel be costed in the C-E system. The costs corresponding to these resources would not be incurred in the absence of supported personnel. We plan to implement by FY87."

4. Correspondence of Cost and Personnel Data for Installation Support  
(See page 14)

Conclusion: Installation Support costs (PECs xxx94, xxx95, xxx96, and PEC 33112 with RC/CCs xx38xx or xx26xx) are reported only for eleven major commands in the H069R data used by VAMOSC. Personnel are reported in the MPC Extract Files for all commands. Costs and personnel strengths should be collected from the same group of commands for the Installation Support algorithms.

Recommendation: The Office of VAMOSC should determine whether there are Installation Support costs associated with those commands whose cost data is not reported in the H069R data used in the VAMOSC system. If such costs exist, they should be included.

Office of VAMOSC Comments: "The Office of VAMOSC concurs and will investigate the significance of installation support costs associated with commands whose cost data is not reported in H069R. Also, we will determine the feasibility of including these costs."

5. Removal of Some PEC xxx96 Costs (See pages 15,16)

Conclusion: Costs for operation of bachelor housing (RC/CC xx465x), food service (RC/CC xx467x), and linen exchange (RC/CC xx468x) are double counted since they are both reported under PEC xxx96 in H069R and incorporated into the standard composite pay rate used to compute pay and allowances. Costs for some dependents' education services are found under RC/CC xx494x and PEC xxx96. These are not currently considered an O&S cost by the C-E system. The civilian PCS costs (RC/CC xx8101) reported under PEC xxx96 represent charges for both support and supported personnel.

Recommendation: The Office of VAMOSC should bypass these PEC xxx96 costs when selecting BOS costs for the C-E system. These can be identified in the H069R data by the following RC/CCs: xx465x, xx467x, xx468x, xx494x, and xx8101. (Although Desmatics does recommend including dependents' education costs and PCS costs for support personnel in Installation Support, these PEC xxx96 records RC/CC xx494x, xx8101 do not properly represent such charges for BOS personnel.)

Office of VAMOSC Comments: "The Office of VAMOSC concurs with Desmatics' recommendation to bypass certain costs within the xxx96 PEC category when calculating BOS costs due to the inclusion of some of these xxx96 PEC costs in the standard composite pay rates used by the system. The change will be implemented by FY87."



6. Alternate Method for BOS Costs (See pages 16-18)

Conclusion: The FY82 method for computing BOS costs in C-E, although a considerable improvement over the FY81 method, can be further refined.

Recommendation: The Office of VAMOSC should consider implementing Desmatics' alternate method (outlined in the text) for determining BOS costs for C-E. This new method involves changes to the total BOS costs, computation of a BOS cost per supported person, and allocation to TMSs based on allocated personnel strengths.

Office of VAMOSC Comments: "Concur. The change will be implemented by FY87. Allocation of BOS costs based on personnel strengths will be more realistic than allocation based on equipment values."

7. Cost Data for RPM (See pages 22-24)

Conclusion: The C-E system uses costs from CACs 51015 and 51070 from F006 system data to compute RPM costs for C-E end items. These accounts only represent charges for maintenance and minor construction of "maintenance and production" and "other" buildings. The definition for this cost category includes costs for numerous other services besides. In addition, it is not clear whether the C-E system processing allows for complete matching of groups of organizations and pools of cost data reported in the F006 system.

Recommendation: The Office of VAMOSC should obtain RPM cost data from the H069R system through the VAMOH preprocessor system. This data is identified by PEC xxx94. All such records should be selected except for those with RC/CCs xx4432 or xx4433 (repairs to family housing or medical facilities) which are accounted for elsewhere by the C-E system.

Office of VAMOSC Comments: "Concur. The Office of VAMOSC plans to obtain RPM costs from the H069R system through an interface with D160. by FY87."

8. Alternate Method for RPM Costs (See pages 24-26)

Conclusion: The current method for allocating RPM costs can be replaced with a simpler method which avoids many of the problems associated with mismatches of cost, organization, and asset data in the current method.

Recommendation: The Office of VAMOSC should consider implementing this new method (outlined in the text) for determining RPM costs for the C-E system.

Office of VAMOSC Comments: "Concur in principle. The Office of VAMOSC agrees that BOS and COM costs should be allocated on the basis of personnel strengths, as Desmatics has recommended in this report. Thus, for the sake of consistency across all Installation Support cost categories, we agree that RPM costs should be allocated in a like manner. The expected implementation date is FY87."

9. Double-Costing of Electric Utilities (See pages 25,26)

Conclusion: Those electric utilities costs reported for C-E end items under Unit Level Consumption will be embedded in RPM costs computed via Desmatics' proposed method for these costs.

Recommendation: The Office of VAMOSC should eliminate these electric utilities costs from RPM by subtracting the worldwide allocated electric utilities costs for each TMS from its worldwide allocated RPM costs. This revised RPM cost should then be the one displayed on the O&S Cost Report for this category.

Office of VAMOSC Comments: "Concur. To avoid double-costing of electric utilities, the Office of VAMOSC will remove electric utilities costs for individual TMSs from their allocated RPM costs and continue to show electric utilities costs under unit level consumption. The expected implementation date is FY87."

10. Communications Cost Clarification (See pages 30,31)

Conclusion: The definition of the Communications Cost category in AFR 400-31, Volume III, could be misleading to a C-E user. It describes two subelements of communications cost (command and base), whereas the algorithm allocates base level costs. Similarly the line item on the O&S Cost Report ("Communications") obscures the scope of this cost category.

Recommendation: The Office of VAMOSC should ensure that in subsequent versions of AFR 400-31, Volume III "Communications" is renamed "Base Communications," along with a corresponding restructuring of the definition. In addition, the line item on the O&S Cost Report should be retitled "Base Communications."

Office of VAMOSC Comments: "The Office of VAMOSC concurs, and will rename the "Communications" cost category "Base Communications" before publication of the FY85 C-E cost reports."

11. Rounding Errors in Allocation (See pages 37,38)

Conclusion: The lack of sufficient precision (i.e., decimal places) in several allocation factors in the C-E system leads to substantial rounding errors, and incorrect allocation of costs, as outlined in Section VI.B.5.

Recommendation: The Office of VAMOSC should provide additional decimal places in the file formats for those allocation factors specified in Section VI.B.5 of this volume.

Office of VAMOSC Comments: "The Office of VAMOSC concurs, and will submit a change to create six decimal places to the right of the decimal for operator factor, fuel factor, base communications factor, and base operations factor by FY87. The RPM factor used in the D160A system currently uses six decimal places."

12. An Alternative Base Communications Cost Algorithm (See pages 38-41)

Conclusion: The current Communications Cost algorithm in C-E has several shortcomings. First, there are several mathematical problems with the Base Communications Factor (BCF). Second, this algorithm requires extensive manual processing of Unit Level Reports and is limited by the response rate to this report.

Recommendation: The Office of VAMOSC should adopt an algorithm of the form outlined in Section VI.4, which computes a communications cost per person supported by base communications, and multiplies this figure by the number of unit mission personnel for each non-base communications end item. This recommendation requires implementation of Recommendation 4 in Volume I of this series.

Office of VAMOSC Comments: "Concur. The Office of VAMOSC plans to implement this recommendation by FY87 pending completion of recommendation No. 4 in Vol I of this series. This recommendation is especially desirable to us because it eliminates the need for base level reports which have historically had a very poor response rate."

13. Indirect Personnel Costs - Support Personnel (See pages 42-48)

Conclusion: Some indirect personnel costs for support personnel are included in Installation Support in the C-E system. The following benefits are not currently included: 1) medical care (including dependents' medical care) for military support personnel, 2) retirement costs for military support personnel, 3) unfunded benefits, civilian support personnel, 4) dependents' education costs (except for H069R PEC xxx96 records with RC/CCs xx494x), and 5) PCS costs for military support personnel. Although civilian PCS costs are included (under PEC xxx96), they contain costs for both support and supported personnel.

Recommendation: The Office of VAMOSC should include all indirect personnel costs for support personnel in Installation Support along with their direct costs. The methodology for accomplishing this for Desmatics' proposed methods for determining BOS, RPM and COM costs is outlined in the text.

Office of VAMOSC Comments: "The Office of VAMOSC concurs that medical care and PCS costs for military support personnel should be included in the C-E system. In a desire to have comparability between the WSSC system and C-E, medical costs for military support personnel (included in WSSC) should be included in C-E. Further, the CAIG explicitly calls for the costing of PCS costs for military support personnel. On the other hand, the Office of VAMOSC does not feel that retirement costs for military support personnel, unfunded benefits for civilian support personnel, and dependents' education costs should be costed. However, our final decision concerning the costing of these three areas will await further guidance from the CAIG."

14. Reporting of Installation Support Strengths (See pages 49-52)

Conclusion: The C-E system could provide additional information and at the same time conform more closely to CAIG guidelines by displaying installation support strengths on its O&S cost report.

Recommendation: The Office of VAMOSC should consider reporting allocated BOS, RPM, and COM personnel strengths on the C-E O&S Cost reports. These allocated strengths can be computed as outlined in the text.

Office of VAMOSC Comments: "Concur. Current CAIG guidelines explicitly call for such a personnel breakout. We will implement by FY87."

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18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)  Cost Allocation O&S Cost VAMOSC		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  This is the fourth volume in a set of reports which document the findings of a study being conducted by Desmatics, Inc. for the Office of VAMOSC. This study constitutes an assessment of the cost allocation algorithms employed with in the Communication-Electronics (C-E) subsystem of the Air Force Visibility and Management of Operating and Support Costs (VAMOSC) system. The C-E system ascertains historical operating and support (O&S) costs for items of AF ground C-E equipment and displays them in 19 categories. This report evaluates the algorithms used to allocate installation support		

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20. costs to individual C-E equipment end items at the type-model-series (TMS) level. Installation support costs consist of base-level costs for: Real Property Maintenance (RPM), Base Operating Support (BOS) and Communications (COM). This volume presents Desmatics' conclusions and recommendations, and comments from the Office of VAMOSC.

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